Adaptive Cruise Control System Questionnaire and Evaluation

1. How comfortable did you feel driving the car using the ACC system?

        1   2   3   4   5   6   7
     Very   Very
  Uncomfortable   Comfortable
      Mean = 6.0   *Stdev. = I.6*

2. How long did it take you to become comfortable using the ACC system?

        I was:

        __15__ comfortable using the ACC system after one hour or less.

        __16__ comfortable using the system after the first day.

        __5__ comfortable using the system after a few days.

        __0__ comfortable using the system after the first week.

        __0__ never comfortable using the ACC system.

3. How easy did you find it was to drive using the ACC system?

        1   2   3   4   5   6   7
     Very   Very
   Difficult   Easy
      Mean = 6.4   *Stdev. = .9*

Briefly describe the types of situations or driving environments where ACC was easiest
   to use:

4. How likely is it that you would have become more comfortable using the ACC system
   given more time?

        1   2   3   4   5   6   7
     Very   Very
    Unlikely   Likely
      Mean = 5.2   *Stdev. = 2.3*

5. How comfortable were you physically (your posture, legs, feet, etc.) when driving
   using the ACC system in comparison with your usual mode of driving?

        1   2   3   4   5   6   7
     Less   More
  Comfortable   Comfortable
      Mean = 5.6   *Stdev. = 1.3*

6. How comfortable were you using the ACC system in the rain or snow?

1	2	3	4	5	6	7	0

Very
Uncomfortable

Very
Comfortable

Did Not
Experience

Mean = 5.2   *Stdev. = 1.5*   *Count of Zeros = 3*

7. How comfortable are you using conventional cruise control in rain or snow?

1	2	3	4	5	6	7	0

Very
Uncomfortable

Very
Comfortable

Did Not
Experience

Mean = 5.1   *Stdev. = 1.6*   *Count* of *Zeros = 0*

8. How comfortable were you using the ACC system on hilly roads?

1	2	3	4	5	6	7	0

Very
Uncomfortable

Very
Comfortable

Did Not
Experience

Mean =5.6   *Stdev. = 1.5*   *Count of Zeros =8*

9. How comfortable were you using the ACC system on winding roads?

1	2	3	4	5	6	7	0

Very
Uncomfortable

Very
Comfortable

Did Not
Experience

Mean = 5.5   *Stdev. = 1.6*   *Count of Zeros = 7*

10. How comfortable would you feel if your child, spouse, parents or other loved ones drove a vehicle equipped with ACC?

1	2	3	4	5	6	7

Very
Uncomfortable

Very
Comfortable

Mean = 6.0   *Stdev. = 1.5*

11. For the following categories, please compare the three modes of operation (Manual control, Conventional Cruise Control, and ACC), and rank them based on your preference. Use (1) to indicate your most preferred and (3) to indicate your least preferred.

Safety	Manual Control	Conventional Cruise	ACC
Mean	*1.5*	*2.6*	*1.8*
Stdev.	*.8*	*.6*	*.6*

Comfort	Manual Control	Conventional Cruise	ACC
Mean	*2.8*	*2.0*	*1.2*
Stdev.	*.5*	*.5*	*.5*

Convenience	Manual Control	Conventional Cruise	ACC
Mean	*2.9*	*1.9*	*1.2*
Stdev.	*.4*	*.4*	*.5*

Driving Enjoyment	Manual Control	Conventional Cruise	ACC
Mean	*2.8*	*2.0*	*1.2*
Stdev.	*.5*	*.5*	*.5*

Please rank the modes of operation, using the numbers (1) to (3), to answer the following questions:

12. In general, under what mode of operation did you feel like you drove fastest? (1 = fastest, 3 = slowest)

	Manual Control	Conventional Cruise Control	ACC
Mean	*1.4*	*2.3*	*2.3*
Stdev.	*.6*	*.7*	*.7*

13. Which mode of operation required you to apply the brakes most often? (1 = least braking, 3 = most braking)

	Manual Control	Conventional Cruise Control	ACC
Mean	*2.0*	*2.3*	*1.7*
Stdev.	*.9*	*.6*	*.9*

14. Under which mode of operation do you drive most cautiously? (1 = most cautiously, 3 = least cautiously)

Manual Control	Conventional Cruise Control	ACC
Mean *2.1*	*2.0*	*1.8*
Stdev. *1.0*	*.6*	*.9*

15. What did you think of the rate of deceleration provided by the ACC system when following other vehicles?

1	2	3	4	5	6	7
Too Slow					Too Fast	

Mean = 3.5   *Stdev. = 1.3*

16. What did you think of the acceleration provided by the ACC system when pulling into an adjacent lane to pass other vehicles?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Too
Slow

Too
Fast

Mean = 3.5   *Stdev. = 1.4*

17. How consistent did you maintain your speed when using the ACC system, as compared to driving manually?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Very
Inconsistent

Very
Consistent

Mean = 6.2   *Stdev. = 1.2*

18. When using the ACC system, as compared to driving manually, did you find yourself more or less aware of the actions of vehicles around you?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Very
Unaware

Very
Aware

Mean = 5.8   *Stdev. = 1.3*

19. When using the ACC system, as compared to driving manually, did you find yourself more or less responsive to the actions of vehicles around you?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Very
Unresponsive

Very
Responsive

Mean = 5.3   *Stdev. = 1.5*

20. When using the ACC system, did you ever feel you didn't understand what the system was doing, what was taking place, or how the ACC system might behave?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Very
Frequently

Very
Infrequently

Mean = 6.1   *Stdev. = 1.1*

21. How easy or difficult did you find it to maintain a safe distance to the preceding
vehicle using each of the following modes of operation?

Manual Control   1   2   3   4   5   6   7

                                            Very   Very
                                        Difficult   Easy

Mean = 4.7   *Stdev. = 2.2*

Conventional Cruise   1   2   3   4   5   6   7

                                            Very   Very
                                        Difficult   Easy

Mean = 3.7   *Stdev. = 1.7*

ACC   1   2   3   4   5   6   7

                                            Very   Very
                                        Difficult   Easy

Mean = 6.2   *Stdev. = 1.2*

22. How comfortable did you feel with your ability to change lanes (to pass other cars)
using each of the following modes of operation?

Manual Control   1   2   3   4   5   6   7

                                            Very   Very
                                       Uncomfortable   Comfortable

Mean = 6.1   *Stdev. = 1.8*

Conventional Cruise   1   2   3   4   5   6   7

                                           Very   Very
                                       Uncomfortable   Comfortable

Mean = 4.9   *Stdev. = 1.9*

ACC   1   2   3   4   5   6   7

                                            Very   Very
                                       Uncomfortable   Comfortable

Mean = 5.6   *Stdev. = 1.7*

23. How did using the ACC system affect your speed, relative to neighboring vehicles, when driving in the following traffic environments?

When using ACC on freeways and expressways, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean = 4.6   *Stdev. = 1.6*   *Count of Zeros = 0*

When using ACC on two-lane rural highways, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean =4.0   *Stdev. = 1.3*   *Count of Zeros = 5*

When using ACC on major arterial streets, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean =3.9   *Stdev. = 1.3*   *Count of Zeros = 10*

When using ACC in heavy traffic, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean = 3.5   *Stdev. = 1.5*   *Count of Zeros = 4*

When using ACC in medium traffic, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean =4.3   *Stdev. = 1.0*   *Count of Zeros = 0*

When using ACC in light traffic, I drove:

1	2	3	4	5	6	7	0
Slower						Faster	Didn't Use

Mean = 5.3   *Stdev. = 1.1*   *Count of Zeros = 0*

24. How did using the ACC system affect your headway (following distance), as compared to manual control, when driving in the following traffic environments?

When using ACC on freeways and expressways, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean = 4.5   *Stdev. = 1.6*   *Count of Zeros = 0*

When using ACC on two-lane rural highways, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean = 4.3   *Stdev. = 1.4*   *Count of Zeros = 4*

When using ACC on major arterial streets, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean = 4.6   *Stdev. = 1.6*   *Count of Zeros = 9*

When using ACC in heavy traffic, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean = 6.0   *Stdev. = 1.8*   *Count of Zeros = 3*

When using ACC in medium traffic, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean = 4.4   *Stdev. = 1.6*   *Count of Zeros = 0*

When using ACC in light traffic, I drove:

1	2	3	4	5	6	7	0
Closer						Farther	Didn't Use

Mean =4.1   *Stdev. = 1.8*   *Count of Zeros = 0*

25. How often, if ever, did you experience "unsafe" following distances when using the ACC system?

1	2	3	4	5	6	7

Very
Frequently   Very
                                                                             Infrequently
Mean = 6.3   *Stdev. = 1.0*

Briefly explain how this may have occurred:

26. Do you feel the headway adjustment feature useful?

1	2	3	4	5	6	7

Strongly   Strongly
Disagree   Agree
Mean = 6.1   *Stdev. = 1.4*

Briefly explain your strategy for adjusting the headway (i.e., when you changed it, and why):

27. For the following questions, please rank the mode of operation you are most likely to use.   (1 = most likely to use, 3 = least likely to use.)

In which mode of operation were you more likely to drive on the highway, interstate, state route, or turnpike? (1 = most likely to use, 3 = least likely to use.)

	Manual Control	Conventional Cruise Control	ACC
Mean	2.9	2.1	1.0
Stdev.	.3	.3	.0

In which mode of operation were you most likely to drive on two lane rural roads? (1 = most likely to use, 3 = least likely to use.)

	Manual Control	Conventional Cruise Control	ACC
Mean	2.4	2.2	1.4
Stdev.	.9	.6	.6

In which mode of operation were you most likely to drive on major arterial streets? (1 = most likely to use, 3 = least likely to use.)

	Manual Control	Conventional Cruise Control	ACC
Mean	1.3	2.6	2.2
Stdev.	.7	.5	.7

28. How safe did you feel using the ACC system?

1   2   3   4   5   6   7

Very   Very
Unsafe   Safe
Mean = 6.4   *Stdev. = .9*

29. Do you think ACC is going to increase driving safety?

1   2   3   4   5   6   7

Strongly   Strongly
Disagree   Agree
Mean = 5.8   *Stdev. = 1.3*

30. While driving using ACC, did you ever feel overly confident?

1   2   3   4   5   6   7

Strongly   Strongly
Disagree   Agree
Mean = 3.6   *Stdev. = 2.2*

3 1. Did you feel more comfortable performing additional tasks, (e.g., adjusting the heater or the radio) while using the ACC system as compared to driving under manual control?

1   2   3   4   5   6   7

Strongly   Strongly
Disagree   Agree
Mean = 5.0   *Stdev. = 1.7*

32. Did you find the ACC system functions distracting (e.g., automatic acceleration and deceleration)?

1   2   3   4   5   6   7

Very   Not At All
Distracting   Distracting
Mean = 6.5   *Stdev. = 1.2*

33. Did you find the ACC system components distracting (e.g., status lights, control buttons)?

1   2   3   4   5   6   7

Very   Not At All
Distracting   Distracting
Mean = 6.2   *Stdev. = 1.3*

34. While using the ACC system, how often, if ever, did the system fail to detect a preceding vehicle?

       1   2   3   4   5   6   7

Always   Never

Mean = 6.2   *Stdev. = 1.0*

35. While using the ACC system, how often, if ever, did the system produce false alarms (i.e., reported the presence of a vehicle when none existed)?

       1   2   3   4   5   6   7

Always   Never

Mean = 6.4   *Stdev. = .7*

36. How easy or difficult do you feel it will be to market a vehicle equipped with an Adaptive Cruise Control (ACC) System?

       1   2   3   4   5   6   7

Very   Very

Difficult   Easy

Mean = 6.4   *Stdev. = .9*

37. How comfortable would you feel if ACC systems replaced conventional cruise control?

       1   2   3   4   5   6   7

Very   Very

Uncomfortable   Comfortable

Mean = 6.5   *Stdev. = .9*

38. Please rank, in order of preference, the following modes of operation for personal use. (1 = most desirable, 3 = least desirable)

_____Manual Control   _____Conventional Cruise Control _____ACC

Mean   2.5   2.2   1.4

Stdev.   .8   .7   .6

39. Would you be willing buy an ACC system in your next new vehicle?

        1   2   3   4   5   6   7

        Very   Very
        Unwilling   Willing

        Mean = 6.5   *Stdev. = .9*

40. Approximately how much would you be willing to spend for this feature in a new vehicle?

        Mean = $410   *Stdev. = $333*

41. Would you be willing to rent a vehicle equipped with an ACC system when you travel?

        1   2   3   4   5   6   7

        Very   Very
        Unwilling   Willing

        Mean = 6.7   *Stdev. = .7*

42. In general, how does driving using the ACC system compare to driving with conventional cruise control?

   Reduced work load was cited most often as a benefit of the ACC *system over conventional cruise control (16 participants). Participants also mentioned that they were more alert and more cognizant of surrounding traffic driving with adaptive cruise* control *(2 participants).*

43. Can you suggest any changes or modifications to the ACC system that might improve it?

   Five participants suggested faster acceleration for passing. Also suggested were providing nighttime illumination of the OEM cruise control buttons and faster acceleration and deceleration rates (2 participants).

44. Did you come close to having any accidents that you feel were related to using the ACC system?

   *When asked if they had come close to having any accidents related to using the ACC system, response of all participants was "No". One participant mentioned that **if** he had not been an alert person, he could have been involved in an accident.*